



Childhood trauma and adolescent psychotic experiences in a community-based cohort: The potential role of positive attributes as a protective factor

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ABSTRACT

Objective: To investigate how a set of positive social and personality characteristics called 'positive attributes' affects the emergence and persistence of Psychotic Experiences (PE) in adolescence.

Method: We used data from a community-based Brazilian High-Risk Cohort (HRC). 2511 6–12 year-old children were evaluated at baseline, and 80.05% completed a 3-year follow-up interview. At baseline, childhood trauma was assessed using parent- and self-report, and positive attributes were assessed by parent-report. Trained psychologists rated self-reported PE at both time points. Linear models evaluated the effect of childhood trauma and positive attributes on PE at follow-up. Mediation models tested i.) the indirect effect of positive attributes on the association between childhood trauma and follow-up PE and, ii.) the indirect effect of childhood trauma and positive attributes on the relationship between PE at baseline and follow-up.

Results: Higher levels of baseline PE ($B = 0.157, p < .001$) and higher childhood trauma ($B = 0.110, p < .001$) were associated with increased follow-up PE. Higher positive attributes predicted lower PE after 3 years, adjusting for the prevalence of baseline PE and childhood trauma ($B = -0.042, p < .022$). Positive attributes partially mediated the relationship between childhood trauma and follow-up PE. The indirect pathway of childhood trauma and positive attributes mediated the association between baseline and follow-up PE.

Conclusions: Higher levels of positive social and behavioral traits in childhood may diminish the subsequent emergence of PE. As these attributes can be promoted, our findings suggest that positive attributes may represent a novel target for preventive interventions in children at risk of developing PE.

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1. Introduction

Non-clinical subthreshold psychotic symptoms in the general population are commonly referred to as Psychotic Experiences (PE). PE have been associated with later transition to psychotic disorders, particularly if they persist over time (Fisher et al., 2013a; Kaymaz et al., 2012; Linscott and van Os, 2013; Peters et al., 2016; Poulton et al., 2000), and to other adverse clinical outcomes, such as non-psychotic psychopathology (Kaymaz et al., 2012), mental health service use (Bhavsar et al., 2017b), suicidality (Honings et al., 2016), and mortality (Sharifi

et al., 2015). However, little research has specifically investigated factors that may protect against the development of PE (Crush et al., 2018). Therefore, it is relevant to examine positive behavioral characteristics as potential modifiable protective factors for the emergence and persistence of PE.

One major risk factor for PE is childhood trauma, which has been consistently associated with the emergence and persistence of PE in clinical and community-samples (Bailey et al., 2018; Trotta et al., 2015; Varese et al., 2012). Several longitudinal studies support traumatic experiences' role as a causal mechanism for PE, especially during neurodevelopment (Arseneault et al., 2011; Kelleher et al., 2008; Kelleher et al., 2013). Moreover, there is evidence showing that cessation of traumatic experiences may decrease the incidence of PE (Kelleher et al., 2013). A recent cross-sectional report from the community-based Brazilian High Risk Cohort (HRC) study has

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confirmed this relationship in late childhood (Moriyama et al., 2018). Importantly, Moriyama et al. (2018) included a psychologist PE rating, dealing with an important limitation of previous studies inquiring PE in children. This methodology, however, has not been investigated using longitudinal data, which is essential to determine if childhood trauma predicts PE irrespective of baseline PE levels. From the biological perspective, PE may represent early alterations of brain circuitry in response to environmental risk factors during neurodevelopment (Drakesmith et al., 2016).

Little research has specifically investigated protective factors for PE. Crush et al. (2018) (Crush et al., 2018) have recently shown that a set of individual (cognitive performance), familial (atmosphere at home), and societal (neighborhood social cohesion) variables operated as protective factors for the emergence of psychotic symptoms in children victims of maltreatment, bullying or domestic violence. The potential protective role of adaptive behavioral traits, such as positive attributes, has not been adequately evaluated yet. Positive attributes encompasses resilience and socioemotional skills measured by positive behavioral characteristics, which might be protective against stressors (Bromley et al., 2006; Heckman and Kautz, 2012). Positive attributes, for instance, interact with intelligence and psychopathology to promote better education (Hoffmann et al., 2016; Vidal-Ribas et al., 2015). Notably, it goes beyond the mere absence of psychopathology, since they are empirically distinct constructs and have interactive proprieties (Hoffmann et al., 2016). Therefore, investigating whether high positive attributes may lower the risk of PE is important because promoting protective factors may be a more reachable task than diminishing risk factors, with lower risk for stigmatization in indicated samples (Vidal-Ribas et al., 2015).

Recent studies addressed possible mediators for the association between childhood trauma and PE, which may determine potential targets for preventive interventions in children exposed to early trauma (Bhavsar et al., 2017a; Evans et al., 2015; Fisher et al., 2013b; Lincoln et al., 2017; Murphy et al., 2015; Pearce et al., 2017; van Nierop et al., 2014; Yamasaki et al., 2016). Mediation analyses investigate the processes by which an independent variable (e.g. childhood trauma) affects an outcome (e.g. PE) (Hayes, 2013). Previous studies found that psychological factors such as low self-esteem, poor emotional regulation, and non-psychotic psychopathology mediate this relationship (Evans et al., 2015; Fisher et al., 2013b; Hardy et al., 2016; Lincoln et al., 2017; Murphy et al., 2015; Pearce et al., 2017; Yamasaki et al., 2016). However, studies that have specifically investigated protective factors as possible explanatory pathways connecting childhood trauma to PE are scarce (Crush et al., 2018).

PE are common in the general population. Meta-analytic findings from >60 studies report on a prevalence of 7.2% and an annual incidence of 2.5% (Linscott and van Os, 2013). Persistence of PE, in contrast, is uncommon (around 20%) (Cougard et al., 2007; Linscott and van Os, 2013). Subjects presenting persistent PE are at higher risk for developing psychotic disorders and lower global functioning (Calkins et al., 2017; Linscott and van Os, 2013). Accordingly, PE is apparently an unstable trait and longitudinal changes may help to discriminate occasional experiences, associated with low levels of suffering and impairment, from early manifestations of potentially severe mental illnesses (Cougard et al., 2007). Thus, it is relevant to investigate mediators for the persistence of PE. In the general population, a meta-analysis found that childhood trauma consistently increased the risk of PE with an odds ratio of 1.76 (Trotta et al., 2015). Therefore, it is arguable that childhood trauma is a mediator for the persistence of PE in the transition from childhood to adolescence. Positive behavioral traits, however, have not been sufficiently explored as protective factors for persistent PE.

Here, we investigate pathways connecting childhood trauma to emergent and persistent PE in adolescence, focusing on the potential protective role of positive factors. Our aims were three-fold. First, we sought to replicate the well established association between childhood trauma and PE. Second, we aimed to explore whether higher positive

attributes were associated with lower levels of PE after 3 years, irrespective of baseline PE levels and exposure to childhood trauma. Third, we sought to test if i.) positive attributes mediate the relationship between childhood trauma and adolescent PE and, ii.) childhood trauma and positive attributes were mediators for the persistence of PE. We predicted that positive attributes would have a protective effect on the emergence of PE. We also hypothesized that positive attributes would partially explain the association between childhood trauma and PE, and that both childhood trauma and positive attributes would mediate the association between baseline and follow-up PE (i.e. persistent PE).

2. Materials and methods

We analyzed data from baseline and 3-year follow-up waves of the Brazilian High-Risk Cohort (HRC). Institutional Review Board of all involved institutions approved the research protocol. For all involved participants, parents or main caregivers provided written informed consent. Children and adolescents provided verbal consent and written consent if they were able to read.

2.1. Study population

The study screened 9937 biological parents of 6–12 years old children from elementary schools of two Brazilian cities, São Paulo and Porto Alegre, using the Family History Screening (FHS) (Weissman et al., 2000). For a detailed description of studies' procedure please see Salum et al. (2015) (Salum et al., 2015). Briefly, after screening phase, we selected 2511 children for an extensive psychiatric and neuropsychological evaluation using two different criteria: a random stratum ($n = 958$) and a high-risk stratum based on the family load of psychiatric symptoms from the FHS ($n = 1553$). Three years later, we invited parents to participate in a follow-up household evaluation; 80.05% completed the follow-up assessment. Main reasons for attrition at 3-year follow-up were refusal (10%) and loss of contact (10%). Children who met criteria for any anxiety disorder at baseline ($p < .01$) were at higher chance to successfully complete the follow-up, whereas lower maternal education ($p < .001$), lower socioeconomic status ($p < .05$), and living in Porto Alegre City ($p < .05$) diminished the probability to attend to the follow-up evaluation (Pan et al., 2017).

2.2. Baseline exposures and mediators

2.2.1. Childhood trauma

We evaluated childhood trauma at baseline using questions from the Childhood Trauma Questionnaire (CTQ). Lay interviewers inquired parents about physical, emotional and sexual abuse, and physical neglect. A trained certified clinical psychologist interviewed children regarding physical neglect, emotional, and physical abuse. We have previously explored the latent structure of this set of CTQ items using both parent- and self-report information. We found an adequate fit for a hierarchical confirmatory factor analysis (CFA) model encompassing a latent childhood trauma factor as a higher-order dimension and parent- and self-report informants as lower-order factors (Salum et al., 2016). For the present study, we used factor scores from this higher-order dimension as the childhood trauma variable.

2.2.2. Positive attributes

We used a subscale of the Development and Well-Being Assessment (DAWBA), the Youth Strength Inventory (YSI) (Vidal-Ribas et al., 2015), to evaluate youth's positive attributes by parent-report. It comprises 24 items regarding children and adolescents' positive characteristics (e.g., if the youth is lively, responsible and humored) and adaptive social behaviors (e.g., if the youth is polite, helpful and kind hearted). It showed adequate goodness-of-fit indices for a 1-factor solution using CFA in our sample: root mean square error of approximation (RMSEA) = 0.057, 90% CI = 0.055–0.059; comparative fit index (CFI) = 0.957; Tucker

Lewis Index (TLI) = 0.950; chi-square test of model fit = 2201.316; $p < .001$ (Hoffmann et al., 2016). We used factor scores from this one-dimension CFA as our positive attribute measure.

2.3. Outcomes

2.3.1. Psychotic experiences

We used the self-report 20-item positive scale from the Community Assessment of Psychotic Experiences (CAPE) to assess PE (Konings et al., 2006; Mark and Touloupoulou, 2016). The positive scale from CAPE inquires about several types of PE including auditory hallucinations, thought insertion and broadcasting, delusional perception, and passivity experiences. At baseline, our sample comprised 6 to 12 year-old children; therefore, we trained psychologists to read items and rate each answer after exploring their clinical significance based on developmental and contextual characteristics of participants, such as cultural background, age appropriateness, and level of conviction related to the reported experience. Children rated yes/no to each item (called herein self-report CAPE); then, psychologists rated the likelihood that the experience was psychotic as (1) improbable, (2) not likely, (3) very likely, and (4) certainly.

We performed a psychometric evaluation for the psychologist-rated CAPE in the present study using CFA separately for baseline and follow-up assessments. Models were adjusted for enrollment stratum (high-risk vs random) using weighting procedures (Martel et al., 2017) and each psychologist was entered as a level in the analysis. PE variables for baseline and follow-up represent factor scores from CFA. Goodness-of-fit measures for all models were in the acceptable range, as reported in Table S1. Dimensional PE data were evaluable for 2246 (89.4%) and 1879 (74.8%) subjects for baseline and follow-up, respectively. For the present study, we only analyzed information from subjects who have successfully completed baseline and follow-up evaluations ($n = 1714$). Subjects with complete data were more likely to have higher socioeconomic status ($t(2244) = -3.400, p < .001$) than those who did not complete follow-up evaluations with available baseline PE data ($n = 532$). There were no differences regarding positive attributes ($t(2244) = -1.793, p > .05$), childhood trauma ($t(2244) = -0.696, p > .05$), baseline PE ($t(2244) = 1.820, p > .05$), sex (chi-square(1) = 0.830, $p > .05$) and study site (chi-square(1) = 0.342, $p > .05$). We re-ran all relevant analyses using self-report CAPE and report results in the Supplemental material:

2.4. Covariates

We used the following variables as covariates in all models: age, study site (São Paulo and Porto Alegre City), sex (by parent-report), and socioeconomic status. We used a national official instrument to ascertain socioeconomic status (The Economic Classification Criterion Brazil) (ABEP, 2010). It ranges from 0 (poorest) to 46 points (wealthiest) and consider level of education of the head-of-household and purchase capacity.

2.5. Statistical analyses

We used separate univariate linear models for evaluating the effect of childhood trauma and positive attributes on PE at follow-up. For all models, we first entered predictor plus covariates in the models; then, in order to account for the effect of baseline levels of PE, we included this variable to the models. We also used linear models including previously cited covariates to test associations between: i. positive attributes and childhood trauma, ii. baseline and follow-up PE. We report effect sizes using Partial Eta Squares. Even though it is debatable how to best apply and interpret r family effect sizes, Partial Eta Squares are usually defined as small ($\eta^2 = 0.01$), medium ($\eta^2 = 0.06$), and large ($\eta^2 = 0.14$) effects (Lakens, 2013).

Finally, we used mediation models to investigate positive attributes (mediator, m) as a pathway connecting childhood trauma (predictor, x) with PE at 3-year follow up (outcome, y), considering all abovementioned covariates of no interest (Fig. 1). To ease interpretation, we used the ratio of indirect to total effect of X on Y as an effect size measure for the indirect pathway, even though this method has several limitation (Hayes, 2013; Preacher and Hayes, 2004). We used parallel mediation to test whether positive attributes (mediator 1, m_1) and childhood trauma (mediator 2, m_2) mediated the persistence of PE (i.e. the effect of baseline PE on follow-up PE) (Fig. 2). In this model, both mediators are included in the indirect path. SPSS version 22 and PROCESS Macro for SPSS v 2.16.3 (Preacher and Hayes, 2004) were used to run all analyses. P -value was set at 5%. We used 10,000 bootstrap samples for bias corrected with a 95% confidence interval for mediation analyses.

3. Results

The mean age at follow up was 13.45 (s.d. 1.9) years, 53.9% ($n = 924$) were male, and 50.7% ($n = 869$) lived in Porto Alegre City. Table S2 depicts descriptive analyses for childhood trauma, positive attributes, and PE measures stratified by sex. Mean age did not differ between males and females and socioeconomic score was higher in males. Regarding clinical variables, positive attributes were higher in females; at both time points, PE were higher in females than in males. Childhood trauma was not significantly different between males and females.

3.1. Positive attributes and childhood trauma predicting follow-up PE

Positive attributes significantly predicted PE after entering covariates ($B = -0.079, F = 20.132, \text{Partial Eta Squared} = 0.012, p < .001$) and baseline PE ($B = -0.073, F = 17.279, \text{Partial Eta Squared} = 0.010, p < .001$) in the models. Negative coefficient values indicate that higher levels of positive attributes were associated with lower levels of PE. Higher childhood trauma predicted higher PE at follow-up, even after adjusting for potential confounders ($B = 0.125, F = 43.945, \text{Partial Eta Squared} = 0.025, p < .001$) and baseline PE ($B = 0.110, F = 33.797, \text{Partial Eta Squared} = 0.019, p < .001$). Both positive attributes ($B = -0.042, F = 5.237, \text{Partial Eta Squared} = 0.003, p < .022$) and childhood trauma ($B = 0.094, F = 21.630, \text{Partial Eta Squared} = 0.013, p < .001$) significantly predicted follow-up PE when entered together in a multivariable model including all covariates and baseline PE.

3.2. Associations between childhood trauma and positive attributes

Childhood trauma was inversely associated with positive attributes ($B = -0.393, F = 259.869, \text{Partial Eta Squared} = 0.132, p < .001$). This association remained significant after adjusting for covariates ($B = -0.383, F = 245.773, \text{Partial Eta Squared} = 0.126, p < .001$).

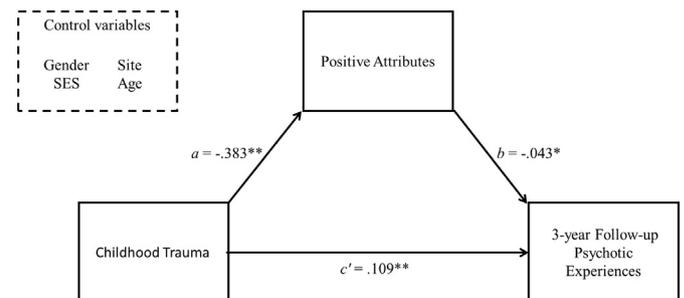


Fig. 1. Mediation model: Positive Attributes as a mediator between Childhood Trauma and Psychotic Experiences; * $p < .05$; ** $p < .001$.

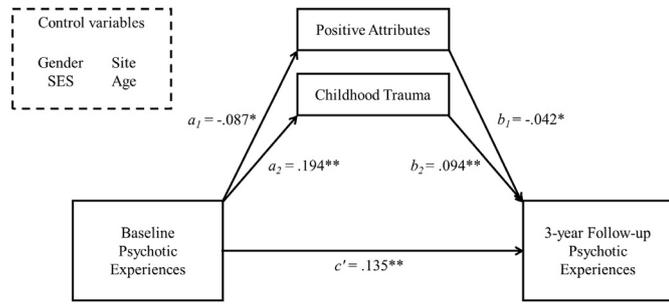


Fig. 2. Parallel mediation model: Positive Attributes and Childhood Trauma as mediators for the relationship between baseline and 3-year follow-up PE; * $p < .05$; ** $p < .001$.

3.3. Baseline PE predicting PE at follow-up

PE at baseline significantly predicted follow-up PE ($B = 0.188$, $F = 59.568$, Partial Eta Squared = 0.034, $p < .001$) even after adjusting for confounders ($B = 0.157$, $F = 39.502$, Partial Eta Squared = 0.023, $p < .001$). There were not significant age or sex by PE interactions.

3.4. Positive attributes as a mediator between childhood trauma and PE

Positive attributes variable was a significant mediator of the previously reported association between childhood trauma and follow-up PE (Table 1). Importantly, this model was adjusted for several potential confounders, such as age, gender, and socioeconomic status. This significant finding persisted even after including baseline PE as a covariate to the model (Effect = 0.0162, Bootstrapped S.E. [Boot SE] = 0.0070, Bootstrapped Lower Confidence Interval[LLCI] = 0.0071, Bootstrapped Upper Confidence Interval[ULCI] = 0.0299), which means that positive attributes mediated the association between childhood trauma and follow-up PE irrespective of baseline PE levels. The ratio of indirect to total effect of X on Y was 0.1458 (Boot SE = 0.0700, LLCI = 0.0258, ULCI = 0.2992), showing that around 15% of the total effect was due to the indirect pathway through M.

Table 1
Statistics of the mediation model: positive attributes as a mediator between childhood trauma and psychotic experiences at follow-up.

Variables' name	Variable type	Outcome: PE at follow-up (y)				
		B	B SE	p-value	95% LLCI	95% ULCI
Total effect model^a						
Constant	constant	-0.2317	0.0902	.0103	-0.4087	-0.0548
Childhood trauma	x	-0.1252	0.0189	<.001	0.0882	0.1622
Socioeconomic status	covariate	-0.0010	0.0020	.6292	-0.0049	0.0030
Age	covariate	0.0008	0.0051	.8725	-0.0091	0.0107
Study site	covariate	0.1161	0.0193	<.001	0.0782	0.1540
Sex	covariate	0.0846	0.0192	<.001	0.0470	0.1223
Direct and indirect effects						
Total effect of x on y		0.1252	0.0189	<.001	0.0882	0.1622
Direct effect of x on y		0.1086	0.0202	<.001	0.0690	0.1482
Indirect effect of x on y via mediator (positive attributes - m)		0.0166	0.0177	n.a.	0.0031	0.0308

Note: PE, Psychotic Experiences; LLCI, Bootstrapped Lower Confidence Interval; ULCI, Bootstrapped Upper Confidence Interval, SE, Standard Error; x = predictor, m = mediator, y = outcome.

^a Model Summary $R = 0.229$, $R^2 = 0.053$.

3.5. Mediators for the association between baseline and follow-up PE

Lastly, we investigated whether childhood trauma and positive attributes were mediators for the association between baseline and follow-up PE in a parallel mediation model. After adjusting for potential confounders, the total indirect pathway consisting of childhood trauma and positive attributes mediated the persistence of PE (Table 2). Childhood trauma and positive attributes mediated the persistence of PE using the bootstrap samples for bias correction method, since the LLCI and ULCI interval did not include zero. The ratio of indirect to total effect of X on Y showed that the total indirect pathway represented 14% of total effect's size (Ratio = 0.1397, Boot SE = 0.0441, LLCI = 0.0747, ULCI = 0.2496). Childhood trauma accounted for the majority of this proportion (Ratio = 0.1163, Boot SE = 0.0398, LLCI = 0.0575, ULCI = 0.2152) when compared to positive attributes (Ratio = 0.0234, Boot SE = 0.0154, LLCI = 0.0031, ULCI = 0.0665).

4. Discussion

In a longitudinal neuropsychiatric developmental cohort, we replicated previous findings showing that childhood trauma was associated with adolescent emergent PE. We showed that positive attributes were inversely associated with PE, even after adjusting for potential confounders, suggesting they may be a protective factor for PE. Furthermore, we found that this set of adaptive behaviors mediated the association between childhood trauma and adolescent PE. Our findings suggest that children's strengths and capacities represent important pathways linking early exposure to trauma with PE. Finally, we found that a common indirect pathway of childhood trauma and positive attributes mediate the persistence of PE over a 3-year period. Both risk and protective factors partially explained a small proportion of the association between baseline and follow-up PE.

Childhood trauma predicted PE even after the rigorous control of potential confounders and PE at baseline, showing that early trauma is associated with PE independently of baseline levels of PE. Numerous studies have shown this relationship (Arseneault et al., 2011; Kelleher

Table 2
Statistics of the parallel mediation model: positive attributes and childhood trauma as mediators for the persistence of psychotic experiences.

Variables' name	Variable type	Outcome: PE at follow-up (y)				
		B	B SE	p-value	95% LLCI	95% ULCI
Total effect model^a						
Constant	Constant	-0.2008	0.0904	.0265	-0.3782	-0.0234
Baseline PE	X	0.1568	0.0249	<.001	0.1079	0.2057
Socioeconomic status	covariate	-0.0014	0.0020	.5002	-0.0053	0.0026
Age	covariate	0.0048	0.0050	.3412	-0.0051	0.0147
Study site	covariate	0.0817	0.0199	<.001	0.0428	0.1207
Sex	covariate	0.0713	0.0193	<.001	0.0334	0.1092
Direct and indirect effects						
Total effect of x on y		0.1568	0.0249	<.001	0.1079	0.2057
Direct effect of x on y		0.1349	0.0250	<.001	0.0859	0.1838
Indirect effect of x on y via mediators						
Mediating effects		0.0219	0.0054	n.a.	0.0125	0.0341
Childhood trauma (m ₁)	mediator	0.0182	0.0050	n.a.	0.0097	0.0296
Positive attributes (m ₂)	mediator	0.0037	0.0022	n.a.	0.0005	0.0097
Specific contrast m ₁ minus m ₂		0.0146	0.0056	n.a.	0.0044	0.0268

Note: PE, Psychotic Experiences; LLCI, Bootstrapped Lower Confidence Interval; ULCI, Bootstrapped Upper Confidence Interval, SE, Standard Error; n.a., not applicable; x = predictor, m = mediator, y = outcome.

^a Model Summary $R = 0.224$, $R^2 = 0.050$.

et al., 2013; Moriyama et al., 2018; Wigman et al., 2012). Our sample adds to this literature by exploring this association in the transition from childhood to adolescence, a fundamental period for the biological mechanisms underpinning how environmental factors cause mental disorders (Paus, 2010, 2013). In addition, we report data using a careful psychologist interview and rating procedure, addressing concerns regarding the reliability of children's self-report to PE (Linscott and van Os, 2013).

We showed that higher positive attributes in childhood predicted lower levels of adolescent PE. To our knowledge, no previous study have shown this association, which should be interpreted with caution as the effect size was low (Partial Eta Squared = 0.010). Nevertheless, this finding might be informative for understanding the nature of socioemotional constructs such as positive attributes, given that higher positive attributes predicted lower PE. Studies exploring causal mechanisms for psychopathology usually report on risk factors. Surprisingly, little research to date addressed protective factors that goes beyond the effect of the absence of risk factors (Hoffmann et al., 2016; Vidal-Ribas et al., 2015). Positive attributes are a good example of such protective factors given that this construct was not originally developed to investigate risk factors for psychopathology (Bromley et al., 2006). Our finding adds to a recent agenda in psychiatry research highlighting the importance of focusing in adaptive behaviors to prevent the burden of mental illness (Jeste et al., 2015).

Mediation analysis is a statistical method widely used in the behavioral sciences (Hayes, 2013). It aims to unravel explanatory pathways connecting two variables. Previous literature addressing mediators for the trauma-PE association revealed interesting results. Fisher et al. (2013b) explored data from the Avon Longitudinal Study of Parents and Children (ALSPAC) and showed that depressive and anxiety psychopathology mediated the association of harsh parenting, bullying victimization, and exposure to domestic violence at 8.5 years of age with psychotic symptoms at age 13 (Fisher et al., 2013b). Psychological aspects also emerged as significant mediators, such as locus of control and self-esteem. Other studies found that maladaptive psychological features (e.g. poor emotional regulation, dissociation) mediated the relationship between childhood trauma and PE (Evans et al., 2015; Fisher et al., 2013b; Hardy et al., 2016; Lincoln et al., 2017; Murphy et al., 2015; Pearce et al., 2017; Yamasaki et al., 2016). In our study, the trauma-PE association was partially mediated by positive attributes, although with a small effect, adding to existing literature a potential protective factor for the emergence of PE in children who are victims of early trauma. If confirmed in future studies, this finding offers new insights for the development of preventive interventions in traumatized children.

Persistence of PE over time partially explains some of the negative outcomes related to these experiences, particularly during neurodevelopment (Calkins et al., 2017; Linscott and van Os, 2013). There is evidence from longitudinal studies linking individual and environmental risk factors to the persistence of PE (Cougard et al., 2007). In our study, the association between baseline and follow-up PE was statistically significant, but with small effect sizes (univariate and multiple regression models Eta Squares = 0.034 and 0.023, respectively). This finding confirms the instability of the PE trait in the general population, with high rates of remission (Linscott and van Os, 2013), and highlight how there is still space for refinement in the psychometric of PE measures.

According to our hypotheses, childhood trauma mediated the association between baseline and follow-up PE. This result is in line with previous findings, confirming the deleterious role of trauma in the persistence of PE. Moreover, we showed that positive attributes mediated PE persistence. However, contrary to our hypothesis, this effect represented only a minor proportion of the total effect. Further research should therefore disentangle specific aspects of positive attributes' role as a mediator for persistent PE. Importantly, we suggest that future studies investigate other protective factors. One important question is

whether children's response to early trauma, measured by constructs like coping skills, may buffer the toxicity of traumatic events in the emergence of psychopathology.

The present study should be interpreted in the light of some limitations. First, we faced significant losses at follow-up in the present report since we depended on data from parent- and self-report at both time points, which may have limited our effect-sizes. Even so, we were able to replicate previously established associations and to raise a potential new one (i.e. positive attributes and PE). Second, reverse causality cannot be ruled out in the present analyses. In our study, it means that PE may be the cause of childhood trauma rather than the opposite way. Contrary to this possibility, we showed that associations survived to the rigorous control of baseline PE; in addition, our longitudinal design diminishes the risk of such methodological issue. Third, our analyses did not consider parent-report PE and children as young as 6 years-old may not adequately report about psychopathology. However, trained psychologists explored and rated every reported PE, considering cultural and developmental aspects to ascertain PE items. Interviewed-based PE report has shown to yield more conservative prevalence rates when compared to self-report. Therefore, our rating procedure may have underestimated the reported associations. Fourth, we did not performed inter-rater reliability for CAPE. Nevertheless, the research team provided continuous training and supervision to psychologists, CAPE presented adequate model fit in CFA, and all models used the psychologists as levels for the analyses. Fifth, children and their parents reported on preceding childhood trauma at baseline. Consequently, since we did not prospectively explore this variable, we cannot exclude the risk of reporting bias. The HRC study is currently going through the time gap between second (3-year follow-up) and third wave (6-year follow-up) of data collection; hence, all mediation models necessarily considered one pair of cross-sectional measures (X-Y, X-M or M-Y) and the effects obtained can be substantially biased until further data is collected (Maxwell and Cole, 2007). Investigations of our hypothesis in birth cohorts that search for very early developmental and psychological risk factors for mental disorders may overcome this limitation (Agnew-Blais et al., 2016; Gallo et al., 2017). Finally, our findings detected significant but small effect sizes for the indirect pathways, suggesting that other factors may also play a major role in the complex relationship between early trauma and PE, such as psychiatric co-morbidity, non-specific psychopathology, and family factors (e.g. family history of mental disorders).

5. Conclusions

Positive attributes in childhood may protect against the emergence of PE in adolescence, and may represent a novel target for preventive interventions in children at risk of developing psychosis.

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Contributors

Pedro M. Pan, Ary Gadelha, Felipe C. Argolo, Mauricio S. Hoffman, Felipe B. Arcadepani undertook statistical analysis and wrote the first draft of the manuscript. Euripedes C. Miguel, Luis A. Rohde, Giovanni A. Salum, Philip McGuire, Rodrigo Bressan designed the study, wrote the protocol, and supervised drafting. All authors contributed to and have approved the final manuscript.

Conflict of interest

Pedro M. Pan received a PhD scholarship from CNPq. Ary Gadelha has served on advisory boards for Janssen and Daiichi Sankyo and he has served as a speaker for Janssen and Aché. Dr. Luis A. Rohde has been a member of the speakers' bureau/advisory board and/or acted as a consultant for Eli-Lilly, Janssen-Cilag, Medice, Novartis, and Shire in the last 3 years. He receives authorship royalties from Oxford Press and ArtMed. The ADHD and Juvenile Bipolar Disorder Outpatient Programs chaired by him received unrestricted

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.schres.2018.06.044>.

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